

A Calibration-Free Approach to Modeling Delta Flows and Transport

#0042

Technical Panel Review

Proposal Name: A Calibration–Free Approach to Modeling Delta Flows and Transport

Applicant Organization: Berkeley, California University of

Principal Lead Investigator(s):

Stacey, Mark

Bayen, Alexandre

Amount Requested: \$390,869

TSP Panel Summary of Findings:

The proposal aims to support water management needs on the days to weeks time scale in response to sudden events such as levee failures. It cites the response to the June 2004 Jones Tract breach as an example that points to the need for approaches such as that the proposal offers and it predicates that need on the inability of current Delta-scale hydrodynamic models to provide meaningful predictive information for such events. From a research perspective the project has great merit and should be funded to determine if the inverse method approach can be successfully applied to the Delta. The relevance to CALFED is very strong and the proposal lays out the current hydrodynamic understanding and modeling approaches used for the Delta and thereby provides a solid footing for why its proposed approach fits well with current and future needs.

The budget doesn't seem to show the cost of the equipment that the research team proposes designing and building, i.e., self-regulating drifter . This could possibly cost \$50,000 to \$100,000 for equipment alone. It is unclear whether these would work in a tidally-driven estuary system. The panel is assuming that funding for this equipment will come from another source.

This project will prove an important link with other Delta hydrodynamic modeling efforts and will add deliverables that provide for disseminating the results of the work more widely;

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the Panel suggested adding an oral presentation at CALFED Science Conference as a deliverable of this effort. If this research is successful it provides a practical application for water managers to use in evaluating hydrodynamics in near-real time when planned or unplanned changes occur in the Delta. The relevance to CALFED is very strong and the proposal lays out the current hydrodynamic understanding and modeling approaches used for the Delta and thereby provides a solid footing for why its proposed approach fits well with current and future needs.

A question which stands out is whether this approach needs to inform process or outcome or whether the interpretations provided in the results of this project will provide for a process-based discussion; it would appear that the combined drifter-fixed instrument experiment and comparison to DSM2 or similar model addresses this concern at least in part. The secondary goal of informing uncertainties in current modeling predictions is valuable, as the complexity of the Delta translates into fundamental uncertainty; water managers and others would benefit greatly from understanding that uncertainty more fully.

Issues/concerns: One major concern is that the time-frame of water operations management's response to events may be shorter than the time-frame in which the research team could gather drifter data and analyze and then respond accordingly.

Relevance to PSP Topic Areas:

High

TSP Technical Rating:

Above Average

TSP Funding Recommendation:

Fund

TSP Amount Recommended: \$390,869

Conditions:

External Technical Review #1

Proposal Title: A Calibration–Free Approach to Modeling Delta Flows and Transport

Proposal Number: 0042

Proposal Applicant: Berkeley, California University of

Purpose

Comments	Although the introduction is rather vague, the investigators eventually make a compelling case for the value of the proposed research. Because of the complex sources and routing of water, conventional modeling of the Sacramento/San Joaquin Delta requires calibration of effective dispersion coefficients from past observations and thus cannot deal with shocks or disturbances to the system such as levee failures or sudden changes in freshwater flows. Management responses to such disturbances are therefore sub-optimal, either wasting fresh water or potentially harming the aquatic ecosystem. The investigators propose a novel calibration-free modeling system informed by both fixed and drifting sensors (Eulerian and Lagrangian monitoring stations). This system is feasible and has the potential to improve management efficiency in the near term. The potential cost savings to society far exceed the cost of the proposed research.
Rating	Superior

Background

Comments	Conceptually the proposal is well developed. The relationship of the proposed effort to scientific knowledge about estuarine hydrodynamics and to past monitoring and analysis of the Delta is well explained. However, there are some details of the monitoring system that are vague. It is difficult to determine how the drifting sensors will be deployed
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External Technical Review #1

	and managed. Do the investigators have a boat and personnel to manage the drifters or do they have a cooperation agreement with USGS field personnel? It was not possible to determine the answers to these questions about the deployment and management of the drifting sensors.
Rating	Above Average

Approach

Comments	The investigators are clearly qualified to conduct the proposed monitoring and modeling. The modeling approach is very well defined as is the importance of the resulting information to managers of the Delta's water resources. The drawback is the lack of information about the deployment and management of the drifting sensors (discussed above).
Rating	Superior

Feasibility

Comments	The project is feasible and well within the capabilities of the researchers. The researchers have direct and extensive knowledge of the delta system, of hydrodynamic monitoring, and hydrodynamic modeling. The probability of success is high. The only part of the proposal that is not clear is how the drifting sensors will be deployed and managed (discussed above).
Rating	Above Average

Budget

Comments	The investigators will provide the drifting sensors, which makes the proposal very cost-effective. Most of the budget is for salaries for two PhD students plus some summer salary support for the investigators. The budget is reasonable for the work proposed.
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External Technical Review #1

Rating	Superior
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Relevance To CALFED

Comments	The proposal provides several compelling examples of how the proposed research could help Delta managers direct and release water more efficiently during system disturbances. The potential savings in terms of valuable fresh water and aquatic health far exceed the cost of the research proposal.
Rating	Superior

Qualifications

Comments	The investigators have impressive research and publication records, and the PI is very familiar with the Sacramento/San Joaquin Delta. They have the facilities and personnel to conduct the proposed work.
Rating	Superior

Overall Evaluation Summary Rating

Comments	The proposed research is feasible and potentially highly valuable to managers of the Sacramento-San Joaquin Delta. The "calibration-free" modeling approach informed by both Eulerian and Lagrangian information might allow much more efficient responses to system disturbances. The proposed effort is both intellectually creative and relevant to management of the Delta. The investigators propose very interesting investigations into the tradeoffs between field data availability and model accuracy and also into the drift between model predictions and observations over time. The proposal is not, however, clearly written. It is necessary to read well beyond the introduction to understand the motivation and importance of the proposed research. Furthermore, the proposal is extremely vague about how the drifter network will be deployed and managed. Where will the drifters be deployed? How long will they be deployed? Who will
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External Technical Review #1

	retrieve them if they get stuck somewhere? Some of the operational details of the field effort are not explicit. Nevertheless, the investigators are well qualified for the proposed work, and they are proposing to provide the drifter equipment which makes this a very cost-efficient proposal for the CALFED program. I think the likelihood of success and the value of the research are both high.
Rating	Superior

External Technical Review #2

Proposal Title: A Calibration–Free Approach to Modeling Delta Flows and Transport

Proposal Number: 0042

Proposal Applicant: Berkeley, California University of

Purpose

Comments	The goals, objectives and hypothesis are stated adequately and reasonably consistent internally. The author' idea is innovative no doubt. Whether the need for such a study is critical with respect to CALFED PSP, is debatable though. I agree that the proposed study may enhance our existing knowledge of delta transport to some extent, but it is not revolutionary. The proposed project can be considered as a research project justifying a hypothesis of predicting delta flows and transport through a coupled system of modeling and observation with lagrangian drifters. I do not agree that the envisioned inverse modeling results will generate novel information relevant to the CALFED needs.
Rating	Sufficient

Background

Comments	The background and conceptual model is clearly stated and well documented. It also explains the basis for the proposed work. Authors explained the need for a real time data collection, however with ongoing real time modeling effort (which is already underway), the applicability of a lagrangian drifter with inverse modeling to predict subtle changes (levee breach etc.) in delta flow and transport is questionable.
Rating	Sufficient

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External Technical Review #2

Approach

Comments	The approach is well designed, however, I have reservation while considering whether or not the system can meet the objectives of the project. Installing and monitoring autonomous drifters for a brief period of time is not a realistic solution to predict overall changes in the delta flow forcing. The organization of the project and also plan for dissemination of the project are demonstrated clearly.
Rating	Above Average

Feasibility

Comments	The authors are well competent and highly skilled to implement their methodology. The approach is fully documented and approach is technically feasible. However, I don't think that the methodology will provide effective and realistic answers to the questions they are seeking.
Rating	Sufficient

Budget

Comments	The budget is adequate for the proposed work. Each task is clearly demonstrated.
Rating	Above Average

Relevance To CALFED

Comments	The proposed project addresses one of the key objectives of PSP by identifying methodology of effectively managing water projects the Delta. The methodology is innovative. But I don't think that the outcome of the project will be useful or will become critical to the CALFED resource managers.
Rating	Inadequate

External Technical Review #2

Qualifications

Comments	Authors are very compatible to perform this task. Lead author has superior track record in investigating these types of works efficiently. They have also reliable infrastructure to accomplish this project.
Rating	Superior

Overall Evaluation Summary Rating

Comments	One of the key emphases of the project is to accurately predict changes in forcing conditions of the delta flow (fresh water input for example). In most cases, these are slow process and installing drifters for a short period of time will not be indicative of the real processes behind these changes. Authors considers about extreme condition of levee breaches and they demonstrated that by performing a real time monitoring system with inverse modeling can provide accurate conditions to the delta transport. Inverse modeling is predictive by nature. A well calibrated forward model (which is under way) can effectively simulate (and predict) future conditions (example, levee breaches, reduction of fresh water input) and hence can provide useful data to the resource managers. Changing model geometry to simulate future conditions is recognized practise to resource managers. An inverse modeling bears the uncertainly in accurately predicting the boundary conditions for the future which is similar to any forward model. Also it is not clearly understood how a lagrangian drifter network can accurately measure delta cross flow or phase shift between different channel networks. A fixed observation system with long term historical data seems to be more viable approach.
Rating	Inadequate

External Technical Review #3

Proposal Title: A Calibration–Free Approach to Modeling Delta Flows and Transport

Proposal Number: 0042

Proposal Applicant: Berkeley, California University of

Purpose

Comments	The goals/idea of this proposal is definitely timely and continues to build and integrate on our existing knowledge from previous and on-going projects.
Rating	Superior

Background

Comments	Yes, this study explained in details the underlying basis for the proposed work and all information needed to understand the basis for the proposed work plans are well documented. There are some mishaps regarding figure number or poor quality graphs for the study site.
Rating	Superior

Approach

Comments	Yes, the approach is well designed and appropriate for meeting the objectives of the project. However, I did not see how the proposed approach would clearly account for the change in geometry (during a levee breach for example); specifically, how the authors would decide where to place the new boundary after a levee breach? Yes, it is clear who will be performing management tasks and administration of the project and adequate resources are set aside to do so. Yes, the products are of value from the project. Is there a plan for widespread and effective dissemination of information gained from the project? Not quite clear
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External Technical Review #3

	that there is a proposed effective plan for dissemination of information gained from this project. For example, at best, all reports are semi-annual with a planned of only 5-10 pages, and a final report with only 15 pages, while the length of the proposal submitted for this review includes 22 pages! This can easily be enhanced by requiring additional reports that includes and describes in details "all" work conducted for this three-year project. In addition, one would expect a few published manuscripts as a result of this great effort. Yes, the contributions to larger data management systems are relevant.
Rating	Above Average

Feasibility

Comments	<p>Yes, the approach is fully documented and technically feasible. However, I rated the likelihood of success > 70%. For example, the authors provided very limited justification for choosing Lagrangian vs. Eulerian observations in their proposed plan (page 12; under "(1)"); not enough justification for using a depth-average approach, even though they mentioned deep channels effects, which is not accounted for in a depth-integrated approach. Also the authors stated all the forces that need to be included in this modeling plan. However, the authors did not address or accounted for wind forcing, and temperature stratification in the water column; not to mention that deep channels will produce the same tidal phase difference as they described in the shallow side embayment vs. an estuary deep channel (see page 2 for example), in their proposed approach.</p> <p>In addition, it is of great importance to some how, integrate and combine the 3-D hydrodynamic model currently being developed</p>
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	<p>by Pete Smith (USGS) with the proposed approach. Currently, the Florida Bay hydrodynamic model had three open boundary conditions, while the forth boundary, runoff from the Everglades National Park, which is not well documented. We used the same optimizing approach proposed for CALDIF (i.e., estimate tidal forcing using Eulerian observations within the bay and add a linear function). This approach was successful, and other researchers also have used it before; even for estuarine water quality modeling. The use of a 3-D model will also provide the flexibility to change the location of a boundary to represent levee breach. For example, we set/created the hydrodynamic model boundaries beyond the water boundary (i.e., inside the wetland itself); we specify no-flow boundary where levee exists; in case of a levee breach all you need to do is, change the "no-flow" at a model grid cell to "flow;" this will result in including and adding the surrounding areas, where the levee broke, to the existing model domain.</p> <p>Yes, the scale of the project is consistent with the objectives and within the grasp of authors.</p>
Rating	Above Average

Budget

Comments	Yes, it is clear how much each aspect of the proposed work will cost including each task, salaries, equipment, etc.? And the proposed budget is reasonable and adequate for the work proposed?
Rating	Superior

Relevance To CALFED

Comments	Yes, the proposal addresses the priorities stated in the PSP. Clearly and directly address one or more of the topics in the Priority Research Topic List. Yes, the proposal address other priorities stated in the PSP such as integration, syntheses, use of existing information, multiple disciplines or modeling, and the information ultimately be useful to CALFED resource managers and policy makers.
Rating	Superior

Qualifications

Comments	The track record of authors in terms of past performance and qualifications are impressive. And the project team is qualified to efficiently and effectively implement the proposed project. The project team have available the infrastructure and other aspects of support necessary to accomplish the project.
Rating	Superior

Overall Evaluation Summary Rating

Comments	The concept proposed for this proposal is great and must be considered for funding. • Track record of authors in terms of past performance is evident. Information provided through the list of their publications and past projects, and resumes provided ample evidence of their qualification. Based on my evaluation, the combined qualifications of the assembled project team are adequate to successfully complete this project. • The project team is capable to implement the proposed project as their track record indicates. • The mix of disciplines among team members is clearly evident, which insures that the required actual experience and resources, to successfully complete this project, are available for
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External Technical Review #3

	the proposed project.
Rating	Superior